Sandy Sutherland Dincher

Full Circle—and Then Some

As an Iowa teenager, Sandy Sutherland's mother had a typical summer job for the American Corn Belt: She plucked tassels off the tops of corn plants. That kept male pollen grains from contacting—and fertilizing—female egg cells in those plants' ears. Pollen from a different strain of corn would fertilize the detasseled plant.

The next spring, farmers would plant the resulting hybrid seed. Their corn yields would far surpass those of their parents' day. It was the 1950's, and hybrid corn was agriculture's New Wave.

In 1980 and 1981, college student Sandy Sutherland, soon to become Sandy Dincher, worked part-time in a tissue-culture research lab at the Agricultural Research Service in Beltsville, Maryland. Tissue culture—the regrowth of whole plants from cells—was New Wave. It had become, and still is, a crucial step in efforts to transform plants with new, heritable genes.

On April 24, 1996, first-grader Lauren and third-grader Amanda Dincher went to school as usual in Durham, North Carolina. But they knew well the visitor who would be part of Southwest Elementary School's week-long celebration of Earth Day. Mom was going to show Amanda and her classmates how to plant and care for a garden in a fishbowl—a tiny symbol of the planet.

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During Earth Week, Sandy Dincher provides hands-on science demonstrations for a 3rd grade class at Southwest Elementary School in Durham, North Carolina. (K7372-12)

Teaching children how nature works and how to work with nature isn't New Wave, but it's a renewal as necessary as spring. "Each person, from youngest to oldest, can help protect and improve the Earth," Sandy Dincher told the kids at Southwest Elementary.

In 1980 and 1981, Sandy was finishing her botany degree at the University of Maryland in College Park. Most afternoons, she worked at

ARS' Beltsville Agricultural Research Center a couple of miles north of the university.

"It was a heady time for biotechnology," she says. "Everyone was racing to be first to exploit *Agrobacterium tumefaciens* as a vehicle to carry new genes into plants."

Scientists had recently figured out how this bacterium caused a plant disorder by inserting its own DNA into chromosomes of the plant. This turned plant cells into slaves, making sugars the bacteria could eat.

"As things turned out, we at ARS weren't first," Dincher says. "It was done elsewhere—but in 1981, while I was at Beltsville. I sensed this was the beginning of a revolution comparable to earlier ones in the fields of vaccines and antibiotics."

At ARS, she plunged into learning and using laboratory techniques. Some of the tasks might seem trivial to the lay person, like how to make sure seeds intended for experiments are truly clean. Disease-contaminated seeds, she points out, could ruin tissue-culture tests to find out which plant strains offer the best chance for successful gene transfers.

"Later, in industry, I trained people to use some of the same methods I learned at ARS. The good stuff doesn't change that much," Dincher says.

At the ARS lab, she worked primarily with plant physiologist Lowell Owens at the Plant Molecular Biology Laboratory (PMBL), then known as the Cell Culture and Nitrogen Fixation Laboratory.

Owens still uses tissue culture—like nearly all his PMBL colleagues and many other plant researchers at the Beltsville center. The approach furthers both basic genetic studies and projects to improve crops such as peaches, tomatoes, rice, and soybeans.

"Anybody who wants to put a new or modified gene into a plant has to use tissue culture of some sort," Owens says.

One of his latest projects began in 1993. He and research associate Gordon Snyder began trying to insert a modified gene into cells of sugar beets, one that might give the beet plants resistance to a fungal disease, *Cercospora* leaf spot. "Some strains of this leaf spot resist chemical fungicides, and other fungicides are being phased out for environmental reasons," Owens explains.

Snyder, who earned his doctorate from Dincher's alma mater in 1987, recently grew transformed sugar beet cells into plants.

"This past March," Owens says, "he got some transgenic plants to produce seed—a major step in the project. We still need to test the plants for leaf-spot resistance."

Today, local high school and college students still work in projects at the ARS lab, reaping the same kinds of benefits Dincher did in the early 1980's. "Lowell made me an active participant in the research, despite my inexperience," she recalls. "My own work found its way into the literature for the first time when he asked me to draw an illustration for a scientific paper.

"He encouraged me to talk to other scientists and to ask them questions when I got interested in their work.

"And when somebody else needed help, we helped. Once, we were all drafted to pick raspberries—an experimental variety. But a berry weighs more in the morning than in the afternoon, and it won't weigh tomorrow what it weighs today." The experience, reinforced by berry-stained fingers, taught Dincher that collecting data at certain times of day might be essential.

Sometimes the students got edible homework: bags of peaches. The assignment from plant physiologist Freddi Hammerschlag was, "Eat the peaches, but bring back the pits!"

Science was where I wanted to be. It became a passion.

From the pits, Hammerschlag excised tiny peach embryos. She eventually devised ways to nurture them into peach trees having new, induced genetic resistance to bacterial leaf spot, a major disease in the Southeast.

"My Beltsville experiences," says Dincher, "reinforced for me that science was where I wanted to be. It became a passion."

Taking It to the Field

In 1981, newly graduated and newly wed, Dincher left her ARS job.

"I needed to work full time to save for graduate school, but we had moved to Virginia and the commute was killing me." So after a stint with a commercial lab in Virginia, she enrolled in Duke University's genetics program at Durham, North Carolina. Durham, along with Raleigh and Chapel Hill, are the three cities among which North Carolina's Research Triangle Park was built.

"I fell in love with the Research Triangle Park area because of its rural qualities and also because it was—and is—a world-class research center. I was sure I could find something interesting to do, and I couldn't wait to start," Dincher says. With a masters degree in botany and genetics from Duke, she joined CIBA-Geigy Corporation in 1985 to work in its agricultural biotechnology research unit.

Biotechnology was definitely New Wave. But Dincher continued using tried-and-true methods she'd learned under Lowell Owens' mentorship.

Among her projects: Dincher conducted one of the first-ever field tests of plants in which scientists had inserted caterpillar-killing genes originally from a bacterium, *Bacillus thuringiensis*, or Bt. "This was the first field test with a Bt gene that turns on only in response to a pest attack," she says. "Other plants' Bt genes are switched on all the time."

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A basic Earth Day concept Sandy Dincher emphasizes to students is "reduce, reuse, and recycle." (K7372-5)

The project led to several new CIBA-Geigy corn varieties that began to be available to farmers this year under the name "Maximizer."

Dincher also worked in CIBA-Geigy's project for "systemic acquired resistance." The phrase refers to a strategy for stimulating a plant's biochemical defenses. "We were the number-one lab studying this phenomenon, which could be another way to cut down on chemical pesticides," she says.

Many plants make defense-boosting compounds—but usually too little, too late, she notes. Scientists believe that one of the world's most famous medicinal drugs is just such a compound. It's made by the willow tree. We know it as aspirin.

Recently, CIBA-Geigy filed for

patent protection on use of a defense-boosting synthetic compound that emerged from studies by Dincher and many other CIBA-Geigy scientists. The compound, BTH, or benzothiadiazole, isn't a pesticide, says Dincher. In tests, spraying minute amounts of BTH spurred powerful biochemical defenses in wheat, corn, rice, cucumber, and other plants.

The compound, Dincher explains, turns up levels of proteins such as chitinases, glucanases, and peroxidases. These and other natural substances help thwart certain insects, fungi, bacteria, or viruses.

"My role was in confirming the compound's activity by measuring how soon the protein responses could be induced," she says.

In her decade at CIBA-Geigy, Dincher wrote or cowrote about 15 major scientific manuscripts for publication. In 1985, she departed the company to continue pursuing a long-term interest—but in a different way.

"I've always been concerned about world hunger," she says. "We have a huge world population and looming problems for the food supply. Having children makes this more urgent—and more personal.

"Traditional crop breeding—and dramatic developments like hybrid corn—have taken us very far. These came about because people learned how nature works—and how to get nature to work better for people."

For thousands of years, people selected and saved the seeds from the best part of the crop and used them to grow a better crop the next year. Gradually, but far more rapidly in the past 150 years, people discovered—and discovered new ways to use—natural laws of genetic inheritance.

"The hybrid revolution was an offshoot of this," Dincher says. "As a result, virtually all the corn we eat is hybrid corn, and it feeds millions of people and their livestock.

"Today, biotechnology offers the best chance for greatly increasing food supplies in the future. But this means we have to do a better job of teaching people about science and agriculture."

To help schools do this, Dincher is pursuing a new career as a science curriculum consultant. But she'll continue her volunteer work in elementary schools.

"I've done this for years. I talk to the kids about plants, but I bring things they can keep: pencils of recycled paper, pictures of how photosynthesis makes sugar, medicinal plants to show the importance of the rain forests. I try to make sure they get their hands dirty. I plant some seeds with them."—By **Jim De Quattro,** ARS. ◆

SCOTT BAUER

Sandy Dincher likens the care and nurturing necessary to maintain this small terrarium to that required for a healthy planet. (K7372-1)